Accelerating the UFS implementation through the integrated and collaborative UFS R2O Project

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EMC, PSL, GSL, CSL, NSSL, ARL, GFDL. AOML, NESDIS
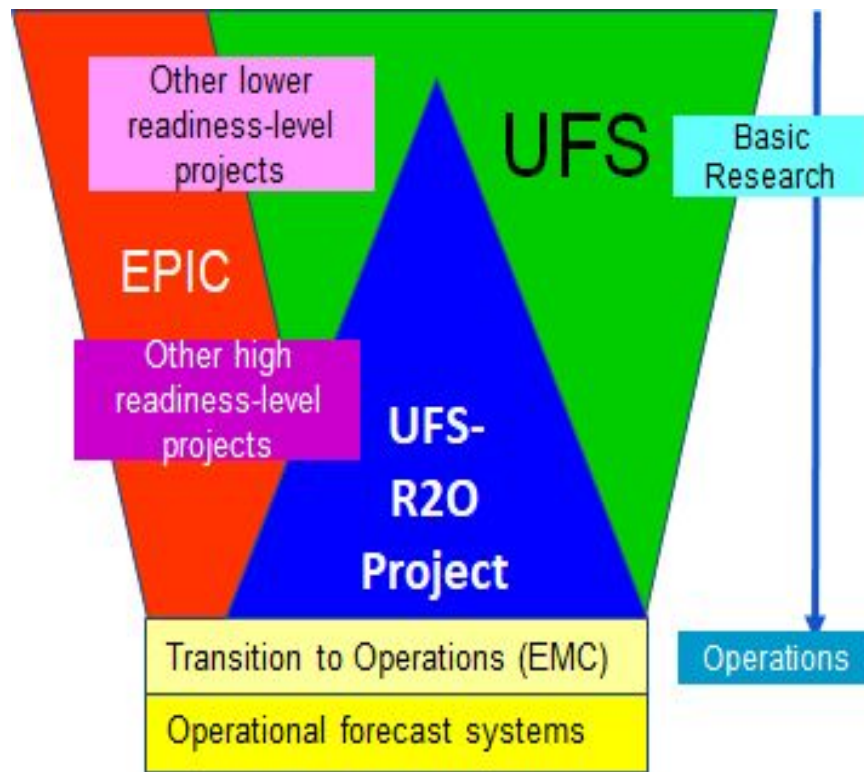
The UFS-R2O Project

- **UFS: Unified Forecast System** is a community-based, coupled Earth modeling system, to support the Weather Enterprise and to serve as the source for NOAA's operational applications.
- **R2O: UFS Research to Operations** aims to develop next-generation global and regional forecast systems for NOAA's operations
- **UFS-R2O Project** is NOAA's largest investment in the UFS, $13M/yr for 2 years (FY20-21), supported and managed by NWS and OAR jointly, to support operational applications by FY24
- **Community** project team with over **100 scientists** from NOAA operational centers, NOAA research laboratories, NCAR, JCSDA, DTC, and Universities

UFS R2O Project vs. UFS

The UFS-R2O project is a subset of the UFS community that is funded by NOAA and focuses on the transfer of innovations into operations (lower part of the "funnel"), but is engaged in some lower "readiness-level" research to ensure the R2O pipeline is continuously fed.

Other lower readiness-level projects

EPIC

Other high readiness-level projects

UFS

Basic Research

UFS-R2O Project

Transition to Operations (EMC)

Operational forecast systems

Operations

UFS-R2O Project Inspiration   UFS R2O

- From UCAR Modeling Advisory Committee (2018 report):
  - NOAA must be "all-in" in developing and deploying a unified community model, with a unified collaborative strategy
  - NOAA Modeling & DA needs to be integrated and collectively managed
- NGGPS selection of FV3 dynamical atmospheric core
- Establishment of Unified Forecast System (UFS)
- From EPIC Vision and Mission:
  - Accelerate scientific research and modeling contributions through continuous and sustained community engagement to produce the most accurate and reliable operational modeling system in the world.

UFS-R2O Project History

- **Summer 2019:**
  - EPIC community meeting, need to better organize the UFS community to prepare
- **Fall 2019:**
  - NWS and OAR program managers agree to coordinate and commit resources
  - Program office invited 3-pager ideas from UFS community (approx 60 submitted, $50M/y)
- **Winter 2019-2020:**
  - Proposal invited (2-year project)
  - Project team and proposal assembled
- **March 12-13, 2020:** Face-to-face peer-review
- **April-May 2020:** Funding finalized
  - $13M/yr: NWS-OSTI $10M and OAR-EPIC & JTTI $3M
- **July 2020:** Project launch, Kick-off meeting (July 9-10), 200+ attended
- **October 1 2020:** First Quarterly Program Review

Participation to the UFS-R2O Kick-off meeting
Total number: 219

Non-NOAA 15.7%
NOAA-Fed 23.7%
NOAA-Aff 60.6%
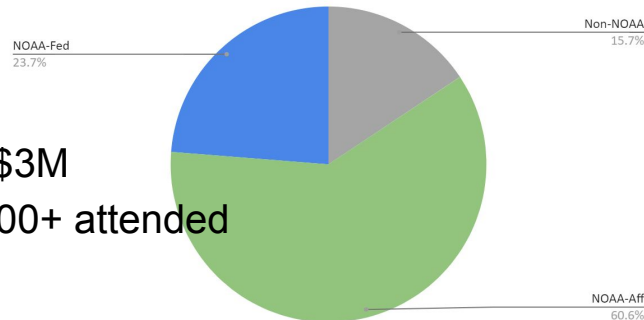
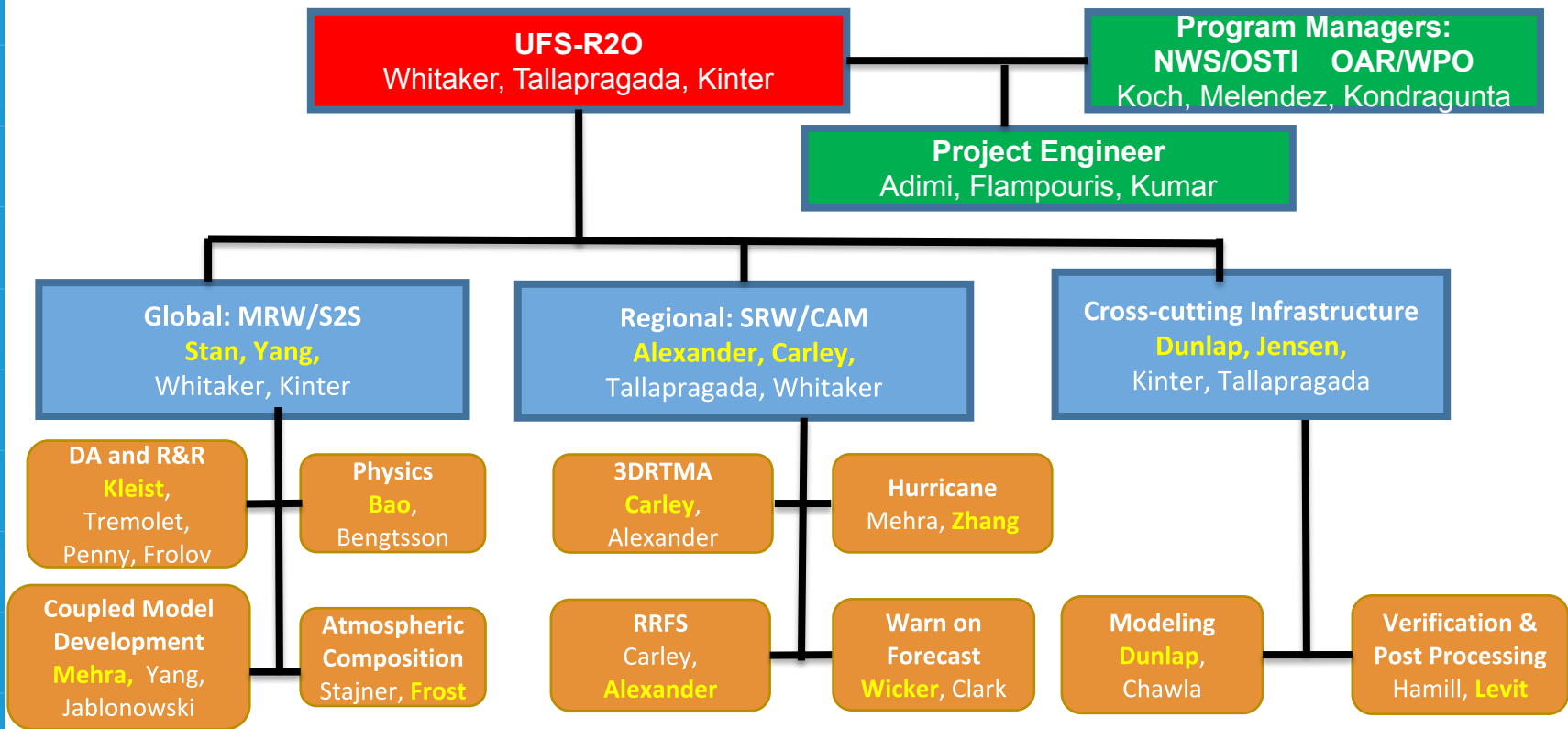# UFS R2O project goals

Develop Next-Generation systems:

Global Coupled (GEFS v13/GFS v17)

Regional Ensemble (RRFS v1) and Hurricane (HAFS)

- Data Assimilation (DA):
  - Coupled: Allow observations of one component (e.g. atmosphere) to update all components.
  - Community JEDI for initialization of all forecast systems
  - Advanced ensemble, hybrid and 4D-Var algorithms, enhanced use of satellite radiances.
- Physics: Next-gen moist physics suite for the atmosphere, unified from convective-allowing to global
- Atmospheric Composition: high-resolution inline air quality prediction and direct aerosol feedback
- Severe weather: Warn on Forecast system for severe weather outbreaks & flash flooding events
- Hurricane Analysis & Forecast System (HAFS) with multiple moving nests

UFS R2O Organization

UFS-R2O
Whitaker, Tallapragada, Kinter

Program Managers:
NWS/OSTI   OAR/WPO
Koch, Melendez, Kondragunta

Project Engineer
Adimi, Flampouris, Kumar

Global: MRW/S2S
Stan, Yang,
Whitaker, Kinter

Regional: SRW/CAM
Alexander, Carley,
Tallapragada, Whitaker

Cross-cutting Infrastructure
Dunlap, Jensen,
Kinter, Tallapragada

DA and R&R
Kleist,
Tremolet,
Penny, Frolov

Physics
Bao,
Bengtsson

3DRTMA
Carley,
Alexander

Hurricane
Mehra, **Zhang**

Coupled Model Development
Mehra, Yang,
Jablonowski

Atmospheric Composition
Stajner, **Frost**

RRFS
Carley,
Alexander

Warn on Forecast
Wicker, Clark

Modeling
Dunlap,
Chawla

Verification & Post Processing
Hamill, **Levit**

Engagement with the Field

 UFS R2O

Forecast Priorities must drive model Research and Development!

- Workshops:
  - "Top 20" forecast issues where model improvement needed (Nov 2020), had representatives of the NWS Forecast Centers and Regions
  - Model-specific issues for global (Jan 2021) and regional (Feb 2021) systems

Code Retirement and Production Suite Simplification

- NOAA operations has an accumulation of legacy models and codes
- We are developing a deliberate plan and process to retire old systems
- This is funded under the UFS R2O Project, and will be featured under the UFS R2O Project website
- First case is the regional predecessors to the RRFS

UFS R2O Project - Next steps

Year 2 planning, FY21

- Continue engagement with the field in area of forecast priorities and code retirement planning
- Integrate other funded NOAA projects (Disaster Supplementals, JTTI, S2S, Grants) with UFS R2O project
- Make model output and tools available to the UFS community
- Committed collaborators are encouraged to contact us and get involved!

Phase 2 planning (Year 3-5, FY22-25)

- Transition UFS R2O phase 1 innovations to operations (HAFS, RRFS, GFS/GEFS)
- Engage and leverage EPIC
  - Infrastructure - software & code management
  - Community Support
  - Cloud computing
- Expand NOAA engagement and investment, in order to expand science and applications
  - Coastal inundation, storm surge
  - Land and surface hydrology
  - Space-weather prediction

UFS R2O related presentations

- **UFS R2O Town Hall**; Jan 14 at 1 pm EST
- **Fourth Special Symposium on Tropical Meteorology and Tropical Cyclones**
  - Hurricane Forecast Improvement Program (HFIP): Development of the next-generation Hurricane Analysis and Forecast System (HAFS) within the Unified Forecast System (UFS); Jan 14 at 4:50 pm EST
  - Transitioning models into operations in NOAA; using the UFS for short-term forecasts
- **Session 2B 11th Conference on Transition of Research to Operations - Advancing NOAA's Unified Forecasting System (UFS) as a Community-Based Modeling System for Research and Operations, Part II: Jan 11 at 1 pm EST**
  - Several presentations
- **25th Conference on Integrated Observing and Assimilation Systems for the Atmosphere, Oceans, and Land Surface (IOAS-AOLS)**;
  - Stylianos Flampouris talk
- **NOAA's Path to Earth System Prediction using UFS**: Jan 14 at 1 pm EST
- **NOAA Modeling Forum Town Hall**: Jan 11 at 1 pm EST

THANK YOU!

For additional Information Contact us at

https://vlab.ncep.noaa.gov/web/ufs-r2o
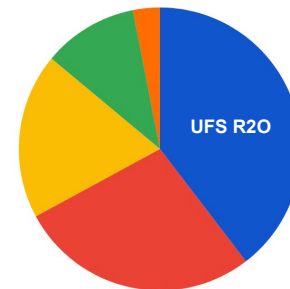
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NOAA Investments in UFS

Unified Forecast System (UFS)

- A community-based, coupled Earth modeling system, to support the Weather Enterprise and to serve as the source for NOAA's operational applications.
- First established as part NOAA/NWS/NGGPS program beginning in 2014
- NOAA continues to invest in UFS through several NOAA's portfolios, including: NGGP, Week 3&4, JTTI, pre-EPIC, and Disaster Supplementals
- Investment areas include infrastructure (ESMF, CCPP, JEDI,...) and science (dynamics, physics, data assimilation, coupling) for global and regional applications
- https://UFSCommunity.org

UFS R2O Project (2019-20; 5 year vision)

- Develop the next-generation global coupled and regional ensemble forecast systems for NOAA's operations in FY24
- NOAA's largest investment in the UFS: $13M/yr, supported and managed by NWS and OAR jointly, and led by members from UFS community
- A Community team (NOAA, NCAR, JCSDA, and universities)
- Committed collaborators are encouraged to engage with the UFS R2O Project!
- https://vlab.ncep.noaa.gov/web/ufs-r2o